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CASCADE COUNTY LINE NORTH INTERSTATE

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# MEDIAN WIDTH DESIGN REPORT

HIGHWAY COMMISSION

STATE OF MONTANA



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CASCADE COUNTY LINE NORTH INTERSTATE

I 15-4 (3) 209 & I-IG 15-5 (5) 230

MEDIAN WIDTH DESIGN REPORT

HIGHWAY COMMISSION

STATE OF MONTANA

Prepared By  
MORRISON-MAIERLE, INC.  
CONSULTING ENGINEERS  
HELENA, MONTANA

PROJECT 275-08-28

April 29, 1965



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## CASCADE COUNTY LINE NORTH INTERSTATE

I 15-4 (3) 209 & I-IG 15-5 (5) 230

### Median Width Design Report

#### Project History

This 4 mile long project extends northeasterly from the confluence of the Dearborn and Missouri Rivers. It is the only section of Interstate remaining to be designed between Helena and Great Falls.

It was originally the middle portion of an 11 mile section through the Missouri River Canyon from Stickney Creek to Hardy Creek which was covered by a reconnaissance report dated January 1963, and prepared by Morrison-Maierle. This report justified the use of four lanes for the whole project length. The middle section of the highway location recommended in this report was not universally acceptable. The north and south sections were approved and design plans for each were developed as separate projects. Additional locations and alignment combinations in the middle portion were studied and the one that was approved for design is known as Alternate 12.

The eleven mile project treated as a whole in the original reconnaissance report gave consideration to the topographic restrictions encountered on the various possible locations. These included encroachments in the river, crossings of the river, winding alignment, and prominent rock ridges and cliffs. The purpose of the reconnaissance studies was to determine the specific location for the highways on a fair comparative basis of all possible locations. This required selection of one typical roadway section for accomplishment. The four-lane narrow-median section with median barrier rail and minimum width shoulders as used on the Interstate through Wolf Creek Canyon was chosen. For consistency the use of this typical section was continued throughout the additional alignment studies in the middle portion.



## Report Purpose

It is recognized that after a location selection is made on a comparative basis there will be some changes required in basic features during the phase of detailed design work. Since this work phase is now underway it is the purpose of this report to review the proposed change in the basic typical section to be used for the southwesterly 2 miles or one-half of the project length. This section traverses flat and gently sloping open terrain which is highly suitable for a 4 lane wide median section. The typical roadway cross-section proposed has a width of 70 feet between centerline of opposing lanes with a 46 foot median with ditch. The section used in the reconnaissance report had 32 feet between centerlines of opposing lanes with an 8 foot paved median with no ditch but with a median barrier guard-rail. Both sections are illustrated in this report.

## Functions of a Median

Since it is proposed that a wide median section be used it is appropriate that the basic functions of a median be reviewed. All have some application to this project. A list of references corresponding to the numbers used in the text will be found in the back of this report.

The functions of a median can be stated as follows:

1. Delineation of opposing streams of traffic.
2. Driver safety and convenience.
3. Control area for out-of-control vehicles.
4. Adequate turnaround area.
5. Storage of disabled vehicles.
6. A suitable area for drainage and snow removal.
7. Work area for maintenance operations.



On a wide median roadway, delineation by color contrast is an aid to vehicle steering and placement. The median should separate opposing traffic streams. It should be highly visible both day and night.<sup>1</sup> This feature would be accomplished on the roadway under consideration by the use of a dirt median ditch in contrast to an asphalt pavement.

Median studies have shown that median width does affect traffic behavior. There is no significant difference in behavior when 4 foot and 12 foot medians were compared, but there was significant difference when narrow medians were compared to medians from 27 feet to 40 feet in width.<sup>2</sup>

Since the ultimate purpose of any highway is safe and convenient travel for the people using it, great consideration should be given to their physical well being and mental attitude when using the highway. Even though a barrier rail in conjunction with a narrow paved median is a deterrent to median cross-over accidents, it is far from an ideal situation for safe and convenient vehicle operation.<sup>3</sup> There is very little elimination of headlight glare for opposing traffic with a narrow median. Studies have shown that there is a definite relationship between the headlight intensity and the ability of a driver to see random objects on the road. It was shown that a 60' median was about the minimum width of median that could be used without the high beam glare affecting the driver.<sup>4</sup>

Research has also proven that a uniform median width has a hypnotic effect on drivers.<sup>5</sup> In this particular section of road under study, it will be the only opportunity to change the width in nearly 14 miles as sections both to the south and north have already been designed as narrow median roadway. A psychological sense of separation is also an aid to drivers.



A wide median will provide adequate turnaround and stationing space for maintenance vehicles. A definite hazard exists, especially when the larger slow moving maintenance vehicles must use the high speed passing lanes for turnarounds. The Highway Patrol also needs adequate space to turn and space for observation of traffic for patrolling purposes and pursuit.

Sight distance is also reduced with a medial barrier, especially for low objects such as game, stock, and debris on the road.

A wide median will provide space for out-of-control vehicles to either be brought back under control or come to a stop without serious damage. A paper on accidents on traverseable medians, by Mr. Fred W. Hurd, concludes that a 50' width is necessary for "roll-over room," and that a 40' traversable median appears preferable to any barrier type.<sup>6</sup>

Even though a median barrier will help to eliminate cross-over accidents it will convert many of them to accidents with following vehicles; this may cause the accident rate to rise, though the accidents will be less serious. The results of surveys of high traffic volume highways in California shows that after the installation of median barrier rail or cable on existing narrow median highways, the accident rate has increased but the number of fatal accidents has decreased for accidents involving the median.

When accidents occur the median area provides space for disabled vehicles to be stored until they can be removed from the roadway. Even a motorist changing a tire in fast moving traffic is a hazard.

Snow removal and roadway drainage can be better accomplished with a wider median. Snow plowed against the median barrier can cause a skidding hazard if allowed to melt thereby allowing the water to run across the road and refreeze as the temperature drops.<sup>7</sup> Even the small amount of snow that accumu-







lates under the medial barrier can cause this hazard. The water running across the road in a light film can cause a skidding accident.

The wider median area will provide space for major maintenance operations. When future major maintenance operations are undertaken on the roadway, the wider median area will provide adequate space for crossing vehicles over for temporary two lane travel and provide a space for operations and storage of materials. It will also separate the workers and the work from the traveling public.

#### Limitations to Median Widths.

Limitations to the width of median mostly appear as initial costs; therefore, they tend to exert a disproportionate amount of influence on the decision of how wide a median is to be used. The factors that limit the width of median are:

1. Additional Right-of-Way must be purchased.
2. Additional construction costs are incurred.
3. The median requires maintenance.

In most studies undertaken, the high cost of additional right-of-way is the limiting factor in determining the width of the median. This limiting factor occurs in areas of high land use and value. The section of highway under discussion does not traverse land of this nature, and the cost of right-of-way could not be considered a limiting factor. (See the comparison of cost summary at the end of this report).

The items of additional construction cost, for wide median, that are involved in this particular project are excavation and embankment, base course material, drainage structures, medial drainage, and the superstructures of bridges across the Missouri River. There is a reduction in cost of the wide



median by the amount of medial guardrail eliminated. The added bridge costs have been shown separately from the added roadway costs.

There will be maintenance costs on a wide median but they will be for different items and should be less than for a narrow median with barrier rail. For the latter, snow removal costs will be higher and there will be costs for maintenance of the barrier guardrail. For wide median there may be some costs incurred for cleanup and mowing.

### COST SUMMARIES

Cost summaries have been developed from preliminary layouts to compare the cost of the proposed Interstate based both upon a narrow median roadway section and a wide median section. It is also presented in two relationships. One is to show the actual cost differences and cost percentages within only the length of highway where it is feasible to use the wide median. This length exceeds two miles and extends from Station 1228+30 to Station 1340+00 with an option to extend the wide median to Station 1357+82. The transitions from wide to narrow median are carried to 1348+50 and 1371+46 respectively. The effective length of wide median is considered to be carried to the stations where the inside edges of divided pavements, noted as point A on the drawing "Typical Roadway Sections", are each 9 feet from the median centerline. The second relationship again shows the same actual cost differences but shows the per-unit-length cost and cost percentages related to the probable total length of the roadway project as a whole. This length extends from Station 1216+40, the north end of the proposed Interstate bridge over the Missouri River at the Dearborn, to Station 1410+00 which is the south terminus of the Hardy Creek South project. There is an equation of plus 1807 feet within these station limits.



## BASIS FOR COST ESTIMATES

The unit prices used for the cost estimates are taken from the 1964 annual average bid prices of the Montana Highway Department with a few exceptions and some slight variations.

The grading quantities between Stations 1216+40 and 1273+30 and 1354+87 to 1410+00 are based on the earthwork balancing in this section between river crossings and to the end of the project respectively. The major rock cuts of the project will be near the beginning station and from 1354+87 to 1410+00. They have a higher unit price assigned to them. The item is listed separately as rock excavation.

The grading quantities between Stations 1280+90 and 1348+50 are based on the use of borrow material for embankment. This area is all flat river bottom land. It is believed that the prices used for dirt excavation and borrow are sufficiently high to include watering and rolling costs. The 4' fill area shown in the illustration of typical sections is not the basis for earthwork computations.

The cost for surfacing is presented on a "per station" basis. The difference in surfacing cost for the wide median and the narrow median is merely for the two wedges of surfacing material required when the median ditch is introduced.

The comparative areas of right-of-way are based on a right-of-way limit 10 feet outside of the cut and fill limits. The fixed costs for right-of-way are reimbursement for separation of parcels, and would be the same in either case.

The total costs for the bridges involved are based on similar costs used in the reconnaissance study for prestressed beam construction and for



steel girder construction. The bridge costs include a contingency item. There are no contingency items included in the roadway costs.

The difference in bridge costs is itemized only for the items which would be different. These include the median rail, bridge rail, and quantities for the resteel and concrete in the decks and curbs. It is assumed there would be no difference in substructure quantities and costs.

### ILLUSTRATIONS

Several drawings are included to illustrate the differences which are reflected in costs and also to show the project area. They are:

1. Typical Roadway Sections
2. Typical Bridge Deck Sections
3. Line Diagram of Alternate 12
4. Gary Cooper Ranch Vicinity Plan-Alternate 12

This photographic map shows the project area. The alignment shown is the same as used during the supplemental reconnaissance studies of this area and is anticipated to have very little change in final design. Frontage roads have been superimposed on this map.

5. Profile of Alternate 12

### CONCLUSIONS

The use of the wide median roadway section on this Interstate project is feasible on the following basis:

1. The terrain is compatible for its use in the limits proposed.
2. It will provide a desirable disruption of continuity of the narrow median roadway section with barrier rail which is required for 6 miles to the north and for 5 miles to the south.
3. It will be a safer highway than the narrow median with barrier rail.
4. From the esthetic standpoint the wide median section is much more attractive.







5. For the relatively small additional expenditure required much more is being purchased in the form and function of the facility.
6. The potential cost savings by reducing to the lower standard undesirable narrow median section is so small in relation to the project cost that it should not be the deciding factor. The total initial cost of the roadway within the 2.93 mile limits of wide median proposed is 3.2 million. The potential reduction in cost by using the low standard narrow median with a barrier rail would be only 6.0%.

The minimum roadway section of 2.20 miles that is proposed for wide median would have an initial cost of \$1.7 million. The use of a narrow median for this section would result in a potential reduction of only 6.4%. Other cost differences are listed in the summaries.

#### Recommendations

On the basis that the wide median section is more desirable for the reasons presented, and that the additional cost to provide the wide median section is a small percentage of the project cost (6%), it is recommended that wide median be constructed from station 1228+30 to station 1357+82 (Option B) and that station 1228+30 to station 1340+00 (Option A) be considered a definite minimum length of wide median construction.



## SUMMARY OF CONSTRUCTION COST

### DIFFERENCE FOR WIDE MEDIAN & NARROW MEDIAN

#### I. BASED ONLY ON THE LENGTH OF HIGHWAY & BRIDGES WHERE WIDE OR NARROW MEDIAN CAN BE USED.

##### OPTION A. Station 1228+30 to 1340+00 (with transition to 1348+50)

Length 116.2 station or 2.20 miles

|   |                   |
|---|-------------------|
| 1. R/W & Roadway Construction Costs using wide median | \$ 409,011.00     |
| R/W & Roadway Construction Costs using narrow median  | <u>375,403.00</u> |
| Difference in Total Cost                              | \$ 33,608.00      |
| Difference in Cost/Station                            | \$ 289.00         |

The use of narrow median with barrier rail would result in an 8.2% decrease in costs for Roadway and Right-of-Way items.

|  |                       |
|--|-----------------------|
| 2. Bridge Construction Costs Using Wide Median | \$1,341,129.00        |
| Bridge Construction Costs using Narrow Median  | <u>\$1,263,000.00</u> |
| Difference in Total Cost                       | \$ 78,129.00          |
| Difference in Cost/Station                     | \$ 672.00             |
| Difference in Cost/Lin. Ft. of Bridge          | \$ 62.00              |

The use of narrow median with barrier rail would result in a 5.8% decrease in costs for bridge construction items.

|  |                       |
|--|-----------------------|
| 3. R/W & Roadway and Bridge Construction Costs using Wide Median | \$1,750,140.00        |
| R/W & Roadway and Bridge Construction Costs using narrow Median  | <u>\$1,638,403.00</u> |
| Difference in Total Cost   | \$ 111,737.00         |
| Difference in Cost/Station                                       | \$ 962.00             |

The use of narrow median with barrier rail would result in a 6.4% reduction of costs for R/W, Roadway and Bridge Construction Costs

##### OPTION B. Station 1228+30 - 1357+82 (with transition to 1371+46)

Length = 154.7 station or 2.93 miles

|   |                      |
|---|----------------------|
| 1. R/W & Roadway Construction Costs using wide median | \$ 676,231.00        |
| R/W & Roadway Construction Costs using narrow median  | <u>\$ 608,151.00</u> |
| Difference in Total Cost                              | \$ 68,080.00         |
| Difference in Cost/Station                            | \$ 440.00            |

The use of narrow median with a barrier rail results in a 10.1% decrease in costs for Roadway and R/W items



|  |                      |
|--|----------------------|
| 2. Bridge Construction Costs using wide median | \$2,555,135.00       |
| Bridge Construction Costs using narrow median  | \$2,428,000.00       |
| Difference in Total Cost                       | <u>\$ 127,135.00</u> |
| Difference in Cost/Station                     | \$ 822.00            |
| Difference in Cost/Lin. Ft. of bridge          | \$ 62.00             |

The use of a narrow median with a barrier rail would result in a 5.0 decrease in costs for bridge construction items.

|  |                       |
|--|-----------------------|
| 3. R/W & Roadway & Bridge Construction Costs using wide median | \$3,231,366.00        |
| R/W, Roadway & Bridge Construction Costs using narrow median   | <u>\$3,036,151.00</u> |
| Difference in Total Cost                                       | <u>\$ 195,215.00</u>  |
| Difference in Cost/Station                                     | \$ 1,262.00           |

The use of a narrow median with barrier rail would result in a 6.0% decrease in Costs for R/W, Roadway & Bridge Construction items combined.



II. BASED ON THE LENGTH OF THE TOTAL PROBABLE GRADING PROJECT LENGTH INCLUDING HIGHWAY AND BRIDGE LENGTHS.

OPTION A. Station 1216+40 to station 1410+00 with wide median to station 1340+00

Length 211.70 station or 4.01 miles

|   |                       |
|---|-----------------------|
| 1. R/W & Roadway Construction Costs using wide median | \$1,337,725.00        |
| R/W & Roadway Construction Costs using narrow median  | <u>\$1,304,117.00</u> |
| Difference in Total Cost                              | 33,608.00             |
| Difference in Cost/Station                            | 159.00                |

The use of narrow median with barrier rail would amount to a reduction in costs of 2.5% for R/W & Roadway Construction Costs.

|   |                     |
|---|---------------------|
| 2. Bridge Construction Cost using wide median | \$2,506,129.00      |
| Bridge Construction Cost using narrow median  | <u>2,428,000.00</u> |
| Difference in Total Cost                      | 78,129.00           |
| Difference in Cost/Station                    | 369.00              |
| Average Difference in Cost/Lin. Ft.           | 38.00               |

The use of a narrow median with barrier rail would result in a 3.1% decrease in costs for Bridge Construction items.

|   |                       |
|---|-----------------------|
| 3. R/W, Roadway and Bridge Construction Costs using wide median | \$3,843,854.00        |
| R/W, Roadway & Bridge Construction Costs using narrow median    | <u>\$3,732,117.00</u> |
| Difference in Total Cost  | 111,737.00            |
| Difference in Cost/Station                                      | \$ 528.00             |

The use of narrow median with a barrier rail would amount to a decrease in cost of 2.9% for R/W, Roadway & Bridge Construction items combined.

OPTION B. Station 1216+40 to station 1410+00 with wide median to station 1357+82

Length 211.70 station or 4.01 miles

|   |                     |
|---|---------------------|
| 1. R/W & Roadway Construction Costs using wide median | \$1,372,198.00      |
| R/W & Roadway Construction Costs using narrow median  | <u>1,304,118.00</u> |
| Difference in Total Cost                              | 68,080.00           |
| Difference in Cost/Station                            | 322.00              |

The use of a narrow median with a barrier rail would amount to a decrease in costs of 5.0% for R/W & Roadway Construction Costs.





|    |  |                     |
|----|--|---------------------|
| 2. | Bridge Construction Cost using wide median   | \$2,555,135.00      |
|    | Bridge Construction Cost using narrow median | <u>2,428,000.00</u> |
|    | Difference in Total Cost                     | 127,135.00          |
|    | Difference in Cost/Station                   | \$ 601.00           |
|    | Difference in Cost/ft.                       | 62.00               |

The use of a narrow median with a barrier rail would amount to a decrease in Cost of 5.0% for Bridge Construction item

|    |  |                     |
|----|--|---------------------|
| 3. | R/W & Roadway and Bridge Construction Costs using wide median  | \$3,927,333.00      |
|    | R/W, Roadway and Bridge Construction Costs using narrow median | <u>3,732,118.00</u> |
|    | Difference in Total Cost                                       | 195,215.00          |
|    | Difference in Cost/Station                                     | 922.00              |

The use of narrow median with barrier rail would amount to a reduction in cost of 5.0% for R/W, Roadway and Bridge Construction Costs.



ESTIMATE OF R/W & ROADWAY & BRIDGE CONSTRUCTION COSTS  
BASED ON ONLY THE LENGTH OF HIGHWAY & BRIDGES WHERE WIDE OR NARROW MEDIAN CAN BE USED

OPTION A

STA. 1228+30 TO 1340+00  
(with transition to 1348+50)

LENGTH 116.2 STA. OR 2.20 MILES

| ITEM | WIDE MEDIAN |          |           |      | NARROW MEDIAN |           |      |  | DIFFERENCE WIDE MEDIAN<br>OVER NARROW MEDIAN |        |
|------|-------------|----------|-----------|------|---------------|-----------|------|--|--|--------|
|      | UNITS       | QUANTITY | UNIT COST | COST | QUANTITY      | UNIT COST | COST |  | ADD  | DEDUCT |

ROADWAY ITEMS

|                         |      |         |         |           |         |         |           |           |  |          |
|-------------------------|------|---------|---------|-----------|---------|---------|-----------|-----------|--|----------|
| Earth Excavation        | cyd  | 152,098 | \$ .55  | \$ 83,654 | 105,857 | \$ .55  | \$ 58,221 | \$ 25,433 |  |          |
| Borrow                  | cyd  | 181,623 | .51     | 92,628    | 117,945 | .51     | 60,152    | 32,476    |  |          |
| Surfacing               | sta  | 103.6   | 1911.00 | 197,980   | 103.6   | 1818.00 | 188,345   | 9,635     |  |          |
| Median Drainage-24" CMP | l.f. | 376     | 7.84    | 2,948     | 0       | -       | -         | 2,948     |  |          |
| Median Inlets           | ea.  | 5       | 107.00  | 535       | 0       | -       | -         | 535       |  |          |
| 36" CMP Drains          | l.f. | 147     | 12.93   | 1,901     | 108     | 12.93   | 1,396     | 505       |  |          |
| 24" CMP Drains          | l.f. | 154     | 7.84    | 1,207     | 120     | 7.84    | 941       | 266       |  |          |
| Guard Rail              | l.f. | 3,020   | 2.56    | 7,731     | 3,020   | 2.56    | 7,731     | 0         |  |          |
| Median Rail             | l.f. | 0       | -       | -         | 10,360  | 3.86    | 39,990    | \$39,990  |  |          |
| Type CM Wire Fence      | Rod  | 1,260   | 8.25    | 10,395    | 1,260   | 8.25    | 10,395    | 0         |  |          |
| Panels                  | ea.  | 63      | 27.50   | 1,732     | 63      | 27.50   | 1,732     | 0         |  |          |
| Totals                  |      |         |         | \$400,711 |         |         | \$368,903 | \$ 71,798 |  | \$39,990 |

RIGHT-OF-WAY

|       |      |        |           |      |        |           |       |           |          |
|-------|------|--------|-----------|------|--------|-----------|-------|-----------|----------|
| AC    | 41.5 | 200.00 | 8,300     | 32.5 | 200.00 | 6,500     | 1,800 | \$ 73,598 | \$39,990 |
| TOTAL |      |        | \$409,011 |      |        | \$375,403 |       |           |          |

BRIDGE ITEMS (STRUCTURES P245 & P411)

|                       |      |         |          |             |         |          |             |           |  |          |
|-----------------------|------|---------|----------|-------------|---------|----------|-------------|-----------|--|----------|
| Sub Structure         |      | -       | -        | \$974,624   | -       | -        | \$974,624   | -         |  | -        |
| Superstructure Conc.  | cyd  | 2,454   | \$ 80.00 | 196,320     | 2,115   | \$ 80.00 | 169,200     | \$ 27,120 |  |          |
| Superstructure Reinf. | lb.  | 464,700 | 0.15     | 69,705      | 388,400 | 0.15     | 58,260      | 11,445    |  |          |
| Bridge Rail           | l.f. | 5,024   | 20.00    | 100,480     | 2,512   | 20.00    | 50,240      | 50,240    |  |          |
| Median Rail           | l.f. | 0       | -        | -           | 1,256   | 8.50     | 10,676      | -         |  | \$10,676 |
| Totals                |      |         |          | \$1,341,129 |         |          | \$1,263,000 | \$ 88,805 |  | \$10,676 |

COMBINED ROADWAY, R/W & BRIDGE

|        |  |  |  |             |  |  |             |           |  |          |
|--------|--|--|--|-------------|--|--|-------------|-----------|--|----------|
| TOTALS |  |  |  | \$1,750,140 |  |  | \$1,638,403 | \$162,403 |  | \$50,666 |
|--------|--|--|--|-------------|--|--|-------------|-----------|--|----------|



ESTIMATE OF R/W & ROADWAY & BRIDGE CONSTRUCTION COSTS  
BASED ON ONLY THE LENGTH OF HIGHWAY & BRIDGES WHERE WIDE OR NARROW MEDIAN CAN BE USED

OPTION B

STA. 1228+30 TO 1357+82 LENGTH 154.7 STA. OR 2.93 MILES  
(with transition to 1371+46)

| ITEM                    | WIDE MEDIAN |          |           | NARROW MEDIAN |          |           | DIFFERENCE WIDE MEDIAN<br>OVER NARROW MEDIAN |           |          |
|-------------------------|-------------|----------|-----------|---------------|----------|-----------|--|-----------|----------|
|                         | UNITS       | QUANTITY | UNIT COST | COST          | QUANTITY | UNIT COST | COST   | ADD       | DEDUCT   |
| ROADWAY ITEMS           |             |          |           |               |          |           |  |           |          |
| Excavation              |             |          |           |               |          |           |  |           |          |
| Earth                   | cyd         | 152,098  | \$ .55    | \$ 83,654     | 105,857  | \$ .55    | \$ 58,221                                    | \$ 25,433 |          |
| Rock                    | cyd         | 141,309  | .90       | 127,178       | 109,018  | .90       | 98,116                                       | 29,062    |          |
| Borrow                  | cyd         | 281,105  | .51       | 143,364       | 194,917  | .51       | 99,408                                       | 43,956    |          |
| Surfacing               | sta         | 134.1    | 1911.00   | 256,265       | 134.1    | 1818.00   | 243,794                                      | 12,471    |          |
| Frontage Road Surfacing | sta         | 17.7     | 148.00    | 2,620         | 17.7     | 148.00    | 2,620  | -         |          |
| Median Drainage-24" CMP | l.f.        | 586      | 7.84      | 4,594         | 0        | -         | -  | 4,594     |          |
| Median Inlets           | ea.         | 7        | 107.00    | 749           | 0        | -         | -  | 749       |          |
| 36" CMP Drains          | l.f.        | 387      | 12.93     | 5,004         | 318      | 12.93     | 4,112  | 892       |          |
| 24" CMP Drains          | l.f.        | 154      | 7.84      | 1,207         | 120      | 7.84      | 941  | 266       |          |
| Guard Rail              | l.f.        | 7,940    | 2.56      | 20,326        | 7,940    | 2.56      | 20,326                                       | -         |          |
| Median Rail             | l.f.        | 0        | -         | -             | 13,410   | 3.86      | 51,763                                       | -         | \$51,763 |
| Type CM Wire Fence      | Rods        | 1,606    | 8.25      | 13,250        | 1,606    | 8.25      | 13,250                                       | -         |          |
| Panels                  | ea.         | 80       | 27.50     | 2,200         | 80       | 27.50     | 2,200  | -         |          |
| Maintenance of Traffic  | l.s.        |          |           | 3,000         |          |           | 3,000  | -         |          |
| Totals                  |             |          |           | \$663,411     |          |           | \$597,751                                    | \$117,423 | \$51,763 |
| RIGHT-OF-WAY            |             |          |           |               |          |           |  |           |          |
|                         | AC          | 64.1     | 200.00    | 12,820        | 52.0     |           | 10,400                                       | 2,420     |          |
| TOTAL                   |             |          |           | \$676,231     |          |           | \$608,151                                    | \$119,843 | \$51,763 |

BRIDGE ITEMS (STRUCTURES P411 & P1255 & P245)

|                      |      |         |          |             |         |          |             |           |          |
|----------------------|------|---------|----------|-------------|---------|----------|-------------|-----------|----------|
| Sub Structure        |      |         |          | 1,950,745   |         |          | \$1,950,745 |           |          |
| Superstructure Conc. | cyd  | 4,049   | \$ 80.00 | 323,920     | 3,495   | \$ 80.00 | 279,600     | \$ 44,320 |          |
| Reinforcing          | lb.  | 769,000 | .15      | 115,350     | 650,400 | .15      | 97,560      | 17,790    |          |
| Bridge Rail          | l.f. | 8,256   | 20.00    | 165,120     | 4,128   | 20.00    | 82,560      | 82,560    |          |
| Median Rail          | l.f. | 0       | -        | -           | 2,063   | 8.50     | 17,535      | -         | \$17,535 |
| Totals               |      |         |          | \$2,555,135 |         |          | \$2,428,000 | \$144,670 | \$17,535 |
| COMBINED TOTALS      |      |         |          | \$3,231,366 |         |          | \$3,036,151 | \$264,513 | \$69,298 |





TOTAL COST OF PROBABLE CONSTRUCTION PROJECT  
BASED ON ENDING WIDE MEDIAN OF 1340+00

OPTION A

STA. 1216+40 TO 1410+00 LENGTH 211.70 STA. OR 4.01 MILES

| ITEMS                   | WIDE MEDIAN |          |           | NARROW MEDIAN |          |           | DIFFERENCE WIDE MEDIAN<br>OVER NARROW MEDIAN |           |           |
|-------------------------|-------------|----------|-----------|---------------|----------|-----------|--|-----------|-----------|
|                         | UNITS       | QUANTITY | UNIT COST | COST          | QUANTITY | UNIT COST | COST   | ADD       | DEDUCT    |
| ROADWAY ITEMS           |             |          |           |               |          |           |  |           |           |
| Excavation              |             |          |           |               |          |           |  |           |           |
| Earth                   | cyd         | 155,195  | \$ .55    | \$ 85,358     | 108,954  | \$ .55    | \$ 59,925                                    | \$ 25,433 |           |
| Rock                    | cyd         | 492,124  | .90       | 442,912       | 492,124  | .90       | 442,912                                      | 0         |           |
| Borrow                  | cyd         | 258,595  | .51       | 131,883       | 194,917  | .51       | 99,407                                       | 32,476    |           |
| Riprap                  | cyd         | 41,732   | 3.00      | 125,196       | 41,732   | 3.00      | 125,196                                      | -         |           |
| Surfacing               |             |          |           |               |          |           |  |           |           |
| Wide Median             | sta         | 103.60   | 1911.00   | 197,980       | 0        | -         | -  | 197,980   |           |
| Narrow Median           | sta         | 87.50    | 1818.00   | 159,075       | 191.10   | 1818.00   | 347,420                                      | -         | \$188,345 |
| Frontage Road           | sta         | 71.90    | 148.00    | 10,641        | 71.90    | 148.00    | 10,641                                       | -         | -         |
| Median Drainage-24" CMP | l.f.        | 376      | 7.84      | 2,948         | 0        | -         | -  | 2,948     |           |
| Median Inlets           | ea.         | 5        | 107.00    | 535           | 0        | -         | -  | 535       |           |
| 36" CMP Drains          | l.f.        | 609      | 12.93     | 7,875         | 570      | 12.93     | 7,370  | 505       |           |
| 24" CMP Drains          | l.f.        | 154      | 7.84      | 1,207         | 120      | 7.84      | 941  | 266       |           |
| Guard Rail              | l.f.        | 14,884   | 2.56      | 38,103        | 14,884   | 2.56      | 38,103                                       | -         | -         |
| Median Rail             | l.f.        | 8,750    | 3.86      | 33,775        | 19,110   | 3.86      | 73,765                                       | -         | 39,990    |
| Type CM Wire Fence      | Rods        | 2,660    | 8.25      | 21,945        | 2,660    | 8.25      | 21,945                                       | -         | -         |
| Panels                  | ea.         | 121      | 27.50     | 3,327         | 121      | 27.50     | 3,327  | -         | -         |
| Maintenance of Traffic  | l.s.        | -        | -         | 11,000        | -        | -         | 11,000                                       | -         | -         |
| Total                   |             |          |           | \$1,273,760   |          |           | \$1,241,952                                  | \$260,143 | \$228,335 |
| RIGHT-OF-WAY            |             |          |           |               |          |           |  |           |           |
| Acreeage                | AC          | 84.2     | 200.00    | 16,840        | 75.2     | 200.00    | 15,040                                       | 1,800     |           |
| Fixed Cost              | l.s.        |          |           | 47,125        |          |           | 47,125                                       |           |           |
| Total                   |             |          |           | \$1,337,725   |          |           | \$1,304,117                                  | \$261,943 | \$228,335 |

BRIDGES, P245, P411, P1255 \$2,506,129 \$ 88,805 \$ 10,676

COMBINED TOTAL \$3,843,854 \$3,732,117 \$350,748 \$239,011





TOTAL COST OF PROBABLY CONSTRUCTION PROJECT  
BASED ON ENDING WIDE MEDIAN AT 1357+82

OPTION B

STA. 1216+40 TO 1410+00 LENGTH 211.70 STA. OR 4.01 MILES

| ITEM | WIDE MEDIAN |          |           | NARROW MEDIAN |          |           | DIFFERENCE WIDE MEDIAN<br>OVER NARROW MEDIAN |               |
|------|-------------|----------|-----------|---------------|----------|-----------|--|---------------|
|      | UNITS       | QUANTITY | UNIT COST | COST          | QUANTITY | UNIT COST | COST   | ADD<br>DEDUCT |

ROADWAY ITEMS

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RIGHT-OF-WAY

|            |      |      |  |        |             |      |  |        |             |           |
|------------|------|------|--|--------|-------------|------|--|--------|-------------|-----------|
| Acreeage   | AC   | 87.3 |  | 200.00 | 17,460      | 75.2 |  | 200.00 | 15,040      | 2,420     |
| Fixed Cost | l.s. |      |  |        | 47,125      |      |  |        | 47,125      |           |
| Totals     |      |      |  |        | \$1,372,198 |      |  |        | \$1,304,118 | \$363,637 |
|            |      |      |  |        |             |      |  |        |             | \$295,557 |

BRIDGES, P245, P411 & P1255

|  |  |  |  |  |             |  |  |  |             |           |           |
|--|--|--|--|--|-------------|--|--|--|-------------|-----------|-----------|
|  |  |  |  |  | \$2,555,135 |  |  |  | \$2,428,000 | \$144,670 | \$ 17,535 |
|--|--|--|--|--|-------------|--|--|--|-------------|-----------|-----------|

COMBINED TOTAL

|  |  |  |  |  |             |  |  |  |             |           |           |
|--|--|--|--|--|-------------|--|--|--|-------------|-----------|-----------|
|  |  |  |  |  | \$3,927,333 |  |  |  | \$3,732,118 | \$508,307 | \$313,092 |
|--|--|--|--|--|-------------|--|--|--|-------------|-----------|-----------|



## REFERENCES

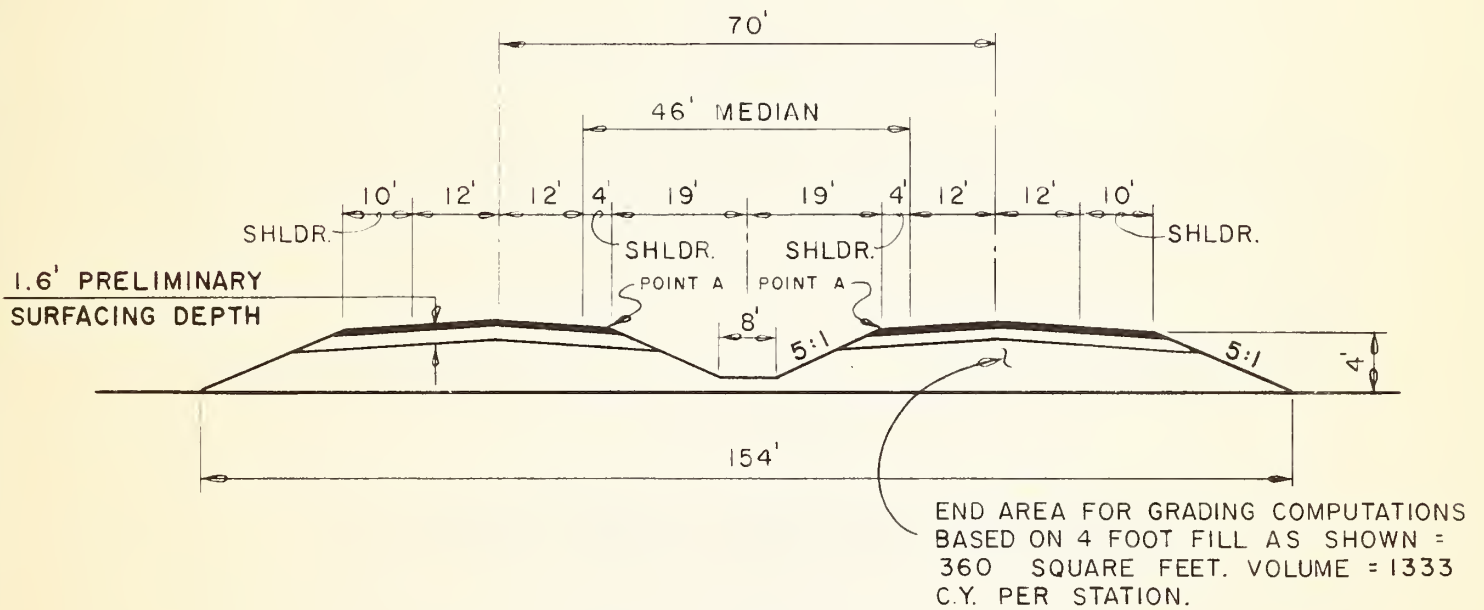
1. A.A.S.H.O., "A Policy on Geometric Design of Rural Highways." Page 216, Paragraph 2.
2. "The Effect of Freeway Medians on Traffic Behavior," C.J. Keese & C. Pinnell, Texas Transportation Institute, 1959.
3. "Freeway Design and Operation, " R.R. Bartelsmeyer, Illinois Highway Engineer, Ill. Division of Highways. Vol XII No. 2, Second Quarter, 1960.
4. "Effect of Median Width on Safe Stopping Sight Distance Against High Beam Headlight Glare," State of Idaho Dept. of Highways., November, 1957.
5. "Interstate or Super Highways," Thos. H McDonald, American Highways, April, 1947.
6. "Median Design: Effect on Traffic Behavior," H.R. B. Bull. 137, Highway Research Board, 1956.
7. Chapter IV, Cross Section Elements - Width and Cross Section, "A Policy on Geometric Design of Rural Highways," AASHO, Pages 217-218.

A brief synopsis of each of the above papers and others may be found in Highway Research Board Bibliography 34 entitled "Medians of Divided Highways."

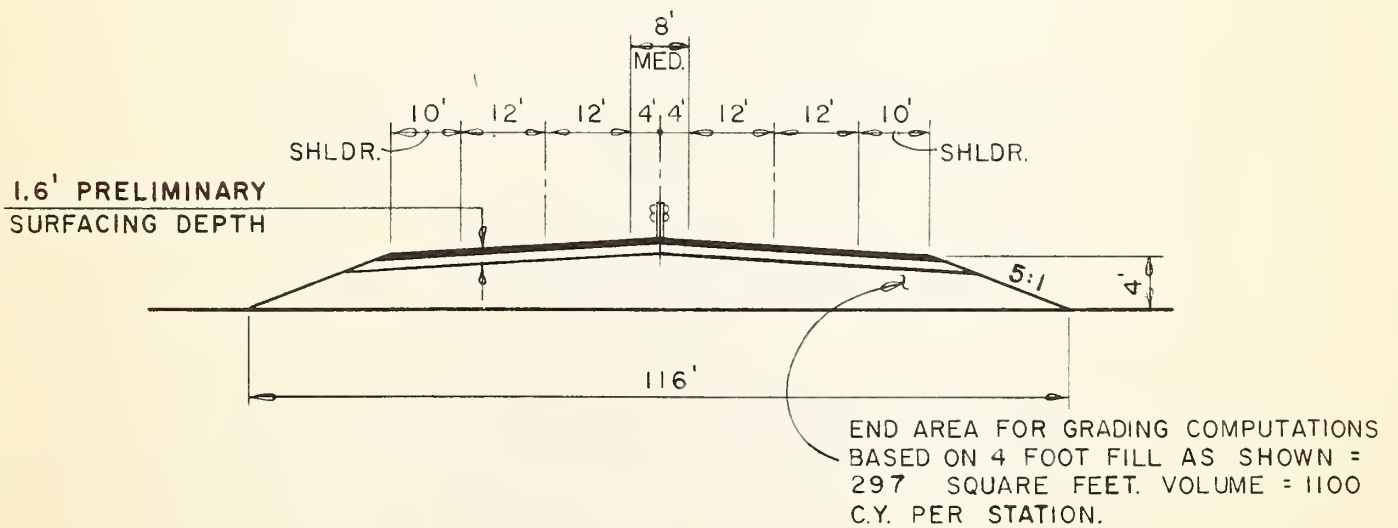


# TYPICAL ROADWAY SECTIONS

NO SCALE



## 4 - LANE WIDE - MEDIAN SECTIONS

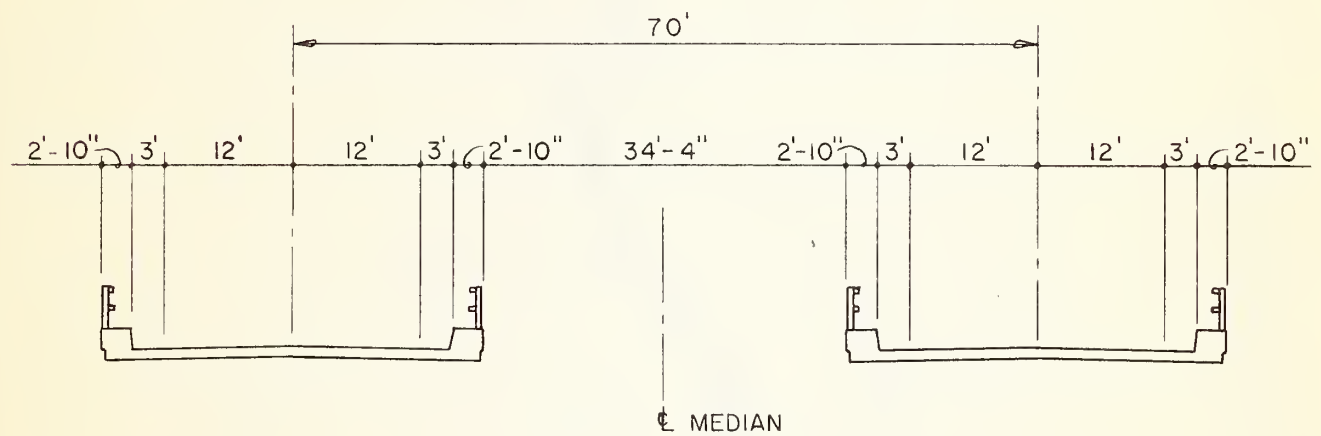


## 4 - LANE NARROW - MEDIAN SECTION

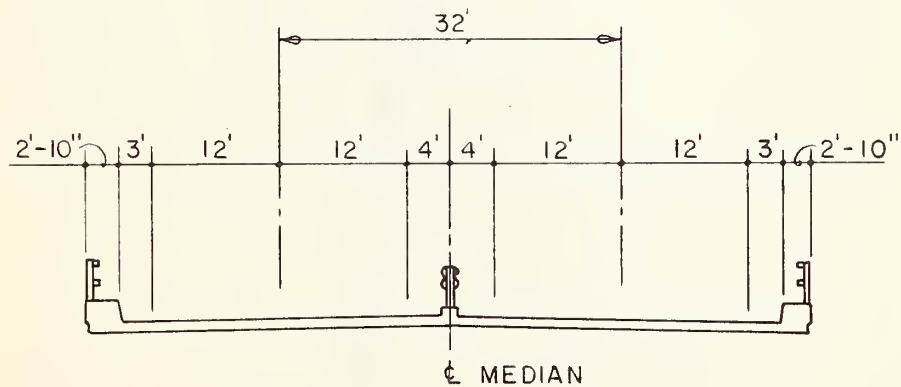


## TYPICAL BRIDGE DECK SECTIONS

NO SCALE



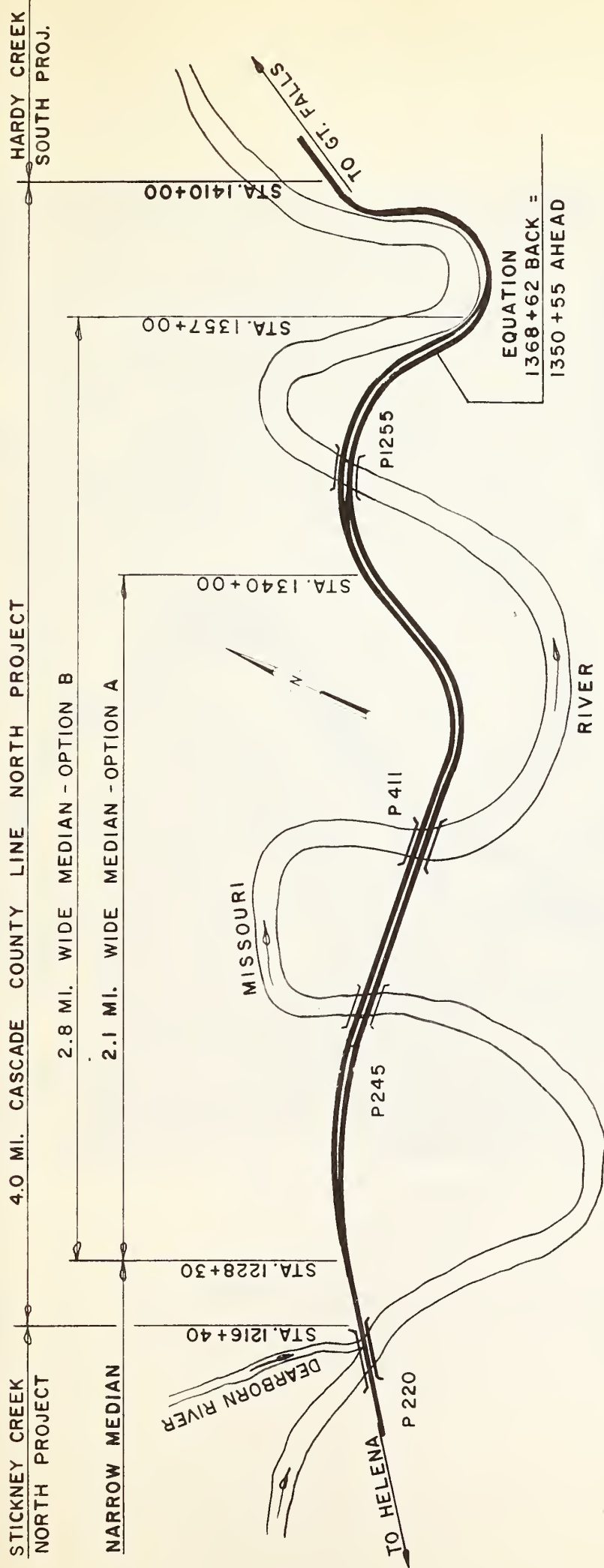
### 4 - LANE WIDE - MEDIAN SECTIONS



### 4 - LANE NARROW - MEDIAN SECTION







# LINE DIAGRAM OF ALTERNATE 12

NO SCALE







GARY COOPER RANCH  
VICINITY PLAN  
ALTERNATE 12 - INTERSTATE 15  
SCALE: 1" = 1000'  
APRIL 29, 1965



## COMMISSION

## MONTANA HIGHWAY COMMISSION

ALEX BLEWETT, CHAIRMAN  
GREAT FALLS

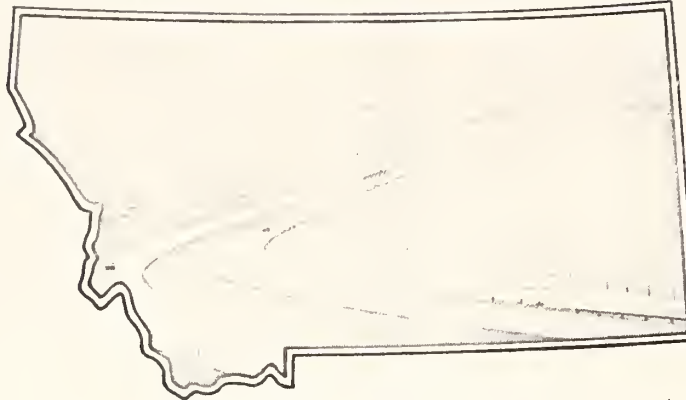
S. N. HALVORSON, VICE CHAIRMAN  
KALISPELL

JOSEPH M. NASS, MEMBER  
POPLAR

ARNOLD M. SWANSON, MEMBER  
BOZEMAN

DALLAS W. VAN DELINDER, MEMBER  
BILLINGS

JOHN D. WHEELER, SECRETARY  
HELENA



HELENA, MONTANA

TIM BABCOCK  
GOVERNOR

PAUL M. JOHNSON  
STATE HIGHWAY ENGINEER

IN REPLY REFER TO:

May 11, 1965

IN:ACQ

Bureau of Public Roads  
Capitol P. O. Box 277  
Helena, Montana

Re: I 15-5(5)230-233  
Cascade Co. Line North.

Gentlemen:

Reference is made to your letter of December 20, 1963, suggesting the use of a wide median in all portions of the subject project where it can be obtained without a substantial increase in construction cost.

Since your approval of Alternate #12 on October 13, 1964, the Consultant has given this matter considerable study and has prepared a report summarizing the findings. You are being furnished 3 copies of the report and a print of a 1" = 200' contour map of the area showing the proposed alignment, median transitions, bridge locations, rest area site, etc.

At this time your comments and approval are requested to proceed with the design utilizing the wide median as recommended in the report and to include a rest area at Station 1235<sup>+</sup>.

Very truly yours,

ACQ:SK:gh

Enclosures

cc: Thompson, (w/cc report)

Briscoe, "

Wickman, "

Jones, "

Morrison-Maierle, Inc.

By

PAUL M. JOHNSON  
State Highway Engineer

*Arthur C. Quinnell*  
Arthur C. Quinnell  
Interstate Engineer







